

*From Research Results
through Available Knowledge
to Board Decisions
and Public Safety*

*Review of Selected Research and Support Projects,
and Suggestions for Refinement of the Research and
Support Performance Measurement Framework
at the Atomic Energy Control Board*

TABLE OF CONTENTS

ACRONYMS USED IN THIS DOCUMENT	ii
EXECUTIVE SUMMARY	i
RECOMMENDATIONS	3
A. OBJECTIVES	7
B. METHODOLOGY	7
C. BACKGROUND: AECB	8
D. BACKGROUND: PERFORMANCE MEASUREMENT IN OTHER SCIENCE BASED FEDERAL GOVERNMENT ORGANIZATIONS	10
E. A REVIEW OF RESEARCH AND SUPPORT PROJECTS COMPLETED IN 1998-99	12
F. TYPES OF RESEARCH AND SUPPORT ACTIVITY AND THEIR VALUE	16
G. WHAT MAKES RESEARCH AND SUPPORT CONTRACTS SUCCESSFUL	20
H. ACHIEVING SUCCESS: PLANNING	21
I. ACHIEVING SUCCESS: IMPLEMENTATION	24
J. ACHIEVING SUCCESS: FOLLOW-UP	25
K. DOCUMENTING SUCCESS	25
L. PROCESS MODEL	26
M. PERFORMANCE MEASURES OF PROCESS, OUTPUTS AND DIRECT OUTCOMES	28
A. Project manager's report on individual completed project, to 'output' point (Stage 11). . . .	29
B. Project proponent's report on individual abandoned project.	29
C. RSP summary report on all completed and abandoned projects.	30
D. Project manager's report on direct outcomes (Stage 12) of individual completed project. . .	30
E. RSP summary report on direct outcomes (Stage 12) of all completed projects.	31
N. PERFORMANCE MEASURES: INTERMEDIATE OUTCOMES	31
O. PERFORMANCE MEASURES: ULTIMATE IMPACTS	32
P. CASE STUDIES	34
Annex A: Interview Guide	35
Annex B: Review of 17 Research and Support Projects—Types of Projects	37
Annex C: Performance Measurement Experience of Other Federal Government Science-Based Institutions	38

ACRONYMS USED IN THIS DOCUMENT

AECB	Atomic Energy Control Board
HR	human resources
OAG	Office of the Auditor General
PM	performance measurement
PMF	performance measurement framework
PPE	Post-Project Evaluation
R&S	research and support
RSC	Research and Support Committee
RSP	Research and Support Program
TOR	terms of reference
WG	working group

From Research Results through Available Knowledge to Board Decisions and Public Safety

Review of Selected Research and Support Projects and Suggestions for Refinement of the Research and Support Performance Measurement Framework at the Atomic Energy Control Board

EXECUTIVE SUMMARY

This study had a dual assignment, to evaluate a sample of AECEB's research and support projects completed in 1998-99 from a management perspective (not for scientific quality); and to refine the draft performance measurement framework that has been proposed for the Research and Support function.

The **recommendations** are found throughout the study. They touch on planning, process and other issues, not just performance measurement, because performance measurement goes hand-in-glove with the planning, management and execution of an activity: For convenience, the recommendations are reproduced in this Executive Summary.

The consultants interviewed 25 key informants within AECEB; 17 had managed research and support projects in 1998-99. The consultants also interviewed members of other federal government science-based organizations.

The specific character and recent history of AECEB are relevant to how research and support are managed and measured. Among the important elements are AECEB's collaborative relationships with the entities it regulates, the fact that its research and support activities are contracted out, and the recent decentralization of its research and support program.

The experience of other federal government science-based organizations shows that implementing a performance measurement regime is neither simple, quick, nor 'stand-alone.' While efficiency monitoring can be done readily, it is much harder to measure the true effectiveness of scientific research carried out for public policy purposes. Ultimate public benefits may result from many factors in addition to the research. As in scientific research, so too in measuring the performance of programs, one must avoid naive assumptions about causes, and simple reliance on easily quantified information. Moreover, adopting performance measurement may require organizations to revise some of their management practices, and staff may need new

skills and attitudes.

The managers of 17 research and support projects were interviewed. These managers felt that their projects had been carried out professionally and that the results corresponded to the projects' terms of reference. In most cases, project managers had a clear idea of how the results would be used in the near term, and to a lesser extent, in the longer term too. They were not satisfied with the present reporting practice (the Post-Project Evaluation).

The consultants found that the present vocabulary of *research* and *support* obscures an important distinction. A better terminology would be to distinguish among *research*, *research support* and *operational support*. Planning and decision-making would be clearer if operational support was dealt with separately from research and research support.

An essential element of AECB's capability to deliver on its mandate—arguably the single most important element—is its *knowledge capacity*. Knowledge capacity is the tangible presence, in AECB's expert staff and among outside experts who are ready to assist AECB, of relevant technical knowledge available for use. A strategic attitude towards research and research support for AECB should stress this element. In addition to the current emphasis on the value of research in generating *new mission-oriented information*, therefore, research and research support should be acknowledged to add value in three additional ways—*building internal knowledge by increasing the expertise of AECB staff*, *building available external knowledge in the form of networks of experts*, and *building available external knowledge through research collaboration with other institutions and by influencing the research agendas of AECB's licensees*.

Before suggesting performance measures for research and support activities, the study explores ways in which these activities should be strengthened, lest the measures mirror or reinforce an incomplete or weak process. Research *planning* needs to be strengthened in terms of articulating a general strategy and multi-year priorities that are sanctioned and communicated by AECB senior executives. The *implementation* of research and support contracts is relatively trouble-free, but middle-level managers could do more to assist in the planning and start-up of projects and could exercise greater oversight of these activities in a collective manner. There should be more dissemination of knowledge at the *follow-up* stage. Finally, project managers do not regard the present Post-Project Evaluation as useful in *documenting success*; they do support the move towards performance measurement and found much that pleased them in the draft Performance Measurement Framework.

The organizing framework for setting out performance measures is a 14-stage 'process model' for conducting contract research and support activities. This model incorporates the present process, which is well established and largely satisfactory from the point of "identifying research needs and priorities in disciplines and sub-programs" (Stage 2) to "acceptance of *outputs* of completed research (successful seminar, appropriate final report), and final payment to contractor" (Stage 11).

The present process needs to be supplemented or strengthened at the front and back ends. At the start, AECB needs to "set the corporate strategic objectives and priorities of research" (Stage 1). After completion of a contract, AECB needs to:

- track *direct outcomes*, the use of results for short term operations and knowledge sharing (Stage 12);
- track *intermediate outcomes*, the use of results in the medium term (Stage 13)
- track the long term influence or *ultimate impact* of results (Stage 14)

The logical tie-back of results is

- from *direct outcomes* (Stage 12) to the *needs and priorities of the disciplines and sub-programs* (stage 2);
- from *intermediate outcomes* (Stage 13) to the *AECB strategy and priorities for research* (Stage 1); and
- from *ultimate impacts* (Stage 14) to *AECB's overall mandate and business goals*.

This framework provides the context for specific suggestions on performance measures related to each stage of the process. The study outlines specific measures of:

- efficiency and short-term effectiveness—measures that reflect the process of both completed and abandoned projects and tell AECB whether results could be used as intended in near-term operations;
- effectiveness in the medium and longer term with respect to new mission-oriented information, building expertise inside and outside AECB, and leverage and collaboration;
- ultimate impact effectiveness in terms of effective available and credible knowledge capacity, continuing research strategy, and the contribution of research and support towards achieving AECB's core mission and business goals.

The following **recommendations** are found throughout the study; the number in parentheses indicates the location.

FUNDAMENTAL RECOMMENDATIONS

AECB should develop a research strategy and research priorities with a minimum five-year horizon. Senior management should communicate these priorities clearly to staff. (See Section E, #E1)

Research and Research Support should be planned and resources allocated in line with the following four objectives:

- ***to generate new mission-oriented information;***
- ***to build internal knowledge, the expert capacity within AECB;***
- ***to build available external knowledge in the form of networks of experts, the wider***

community of individuals and institutions that are ready to contribute knowledge pertinent to AECB's needs; and

- to build available external knowledge through research collaboration with other institutions and by influencing the research agendas of AECB's licensees. (See Section F. #F3)

AECB should estimate the ultimate impact of research and research support in the following terms:

- existence of documented, credible technical studies in place that have stood the test of time, forming a base for confidence in regulations;

- existence of information, tools and expertise (internal and external) to recommend correct and defensible licensing decisions;

- existence of an AECB research strategy, reflecting AECB's strategic priorities and a risk assessment of knowledge gaps, for five years forward from the present; and

- contribution of AECB's contracted research and support activities to achieving its core mission and business goals. (See Section O. #O1)

AECB should develop high-level indices of its performance against its mandate and business goals. (See Section O. #O2)

AECB should develop a logic model of the influence of research and research support activities on the attainment of business results. (See Section O. #O3)

AECB should develop an evaluation framework for evaluating the ultimate impact of its research and research support activities in anticipation of such an evaluation three years after confirmation of its first research strategy. (See Section O. #O4)

RECOMMENDATIONS ON PROGRAM MANAGEMENT ISSUES

The 'support' element of R&S should be divided into research support and operational support. (See Section F. #F1)

Operational Support should be funded and managed separately from Research and Research Support. (See Section F. #F2)

Section Heads and Directors should oversee the research and support activities in their own areas by helping staff to generate proposals in light of strategic priorities and to initiate, manage and follow-up approved projects. (See Section E. #E2)

Section Heads and Directors should act as co-stewards of the R&S budget by sharing information to ensure that funds neither lapse nor become allocated to secondary projects. (See Section E. #E3)

Sections and Divisions should include the capacity to propose and manage research within their HR plans. (See Section H. #H5)

Sections and Divisions should use the time reporting system to track the time invested in managing research projects. (See Section I. #I1)

RECOMMENDATIONS ON RESEARCH AND SUPPORT PLANNING AND MANAGEMENT

The R&S Process Model should be clarified and communicated to staff. (See Section L. #L1)

Research and research support proposals should be as detailed as possible with respect to intended start date, dissemination of results, and initial utilization of results. (See Section M. #M1)

Research proposals that are inconsistent with AECB's research strategy and priorities should not be considered for funding without a credible case for special exemption. (See Section H. #H1)

Project managers should formally confirm the terms of reference of a research or research support contract after initial meeting(s) with the contractor at which the TOR may be adjusted if necessary. (See Section G. #G1)

Project proponents, Section Heads and Directors should be required to signal potential slippage (i.e. inability to start or complete a project, or surplus at the end of a project) as early as possible. (See Section H. #H3)

High-priority proposals that could not be funded at the start of the fiscal year should be the first candidates for funds freed up by slippage, without requiring a new application process. (See Section H. #H4)

AECB should support greater proactive sharing of research results with experts outside AECB. (See Section J. #J1)

RECOMMENDATIONS ON MEASURING AND REPORTING PERFORMANCE

The Post-Project Evaluation should be integrated into the performance measurement activities proposed in this study. (See Section K. #K1)

The manager of a completed research or research support project should report on key

elements of the process followed and on outputs within three months of project completion. The process elements include financial, schedule and communications performance measures. The output elements include fulfilment of terms of reference, quality of results and reporting, proportions of intended audiences reached, and collaboration. (See Section M. #M2)

The proponent/manager of an approved but abandoned research or research support project should report on the circumstances within three months of its abandonment. (See Section M. #M3)

The RSP Manager should produce a report on process and output issues for completed and abandoned projects within five months of the end of the fiscal year, based on the individual reports of project managers or proponents. (See Section M. #M4)

The manager of a completed research or research support project should do a report on its direct outcomes approximately nine months after completion of the project, or later if the direct outcomes are still anticipated. (See Section M. #M5)

The RSP Manager should do an annual summary report on direct outcomes of completed projects, based on the individual reports of project managers. (See Section M. #M6)

Project managers and their colleagues in sub-programs, sections or divisions should report annually to senior management and RSC on the intermediate outcomes of research and research support activities. The number of years past that the reports cover will vary with the nature of the discipline and its research/ research support history. (See Section N. #N1)

AECB should review and promote its research activities by means of case studies. (See Section P. #P1)

Where relevant, Executive Committee and the Board should note the links between research results and their decisions. (See Section H. #H2)

A. OBJECTIVES

The study objectives¹ are:

- to review the draft performance measures proposed for the Research and Support Program (RSP) in the draft Performance Measurement Framework (PMF) dated April 20, 1999;
- to assess the outcome of a sample of 15 to 18 Research and Support projects completed in 1998-99, using these measures;
- to make recommendations towards establishing formal monitoring of the effectiveness of the RSP.

The study puts greater emphasis on the first and third objective than on the second: first, because the highest priority as expressed by the client was to contribute to the performance measurement pilot test in RSP; and second, because the PMF was only drafted in 1999-2000, so it could not be used legitimately to evaluate R&S projects completed in 1998-99.

B. METHODOLOGY

The contractor (Agora Management Associates) marshaled a team of two principals and two advisors. The principal members, who conducted all the interviews, were Robert Czerny and Michael Peterson, general management consultants with experience in strategic planning, management reviews, work process improvement and other areas. The advisors were Dr. Gerald Halpern (for program evaluation and performance measurement) and Dr. Jean-André Potworowski (strategic planning and management of scientific research).

The client (Dr. Jovica Riznic, A/Manager, RSP) identified 17 R&S projects, out of 59 completed in 1998-99, that collectively gave a sense of the range of work done. Thus, the sample of projects was not structured to be statistically representative, and no conclusions have been suggested as to how much of the research and support work can be characterized in any particular manner—including, whether or not it can be regarded as effective.

After initial discussions with the client, it was decided that managers at the Director and Director-General level should be interviewed in addition to the managers of the 17 projects. Interpreting the value and success of R&S projects hinges on the performance expectations for

¹Taken with slight rewording from the Statement of Work attached to Contract 99-33, "Research and Support Program Performance Measurements."

those projects. These expectations would naturally 'come down from above.'

The following key informants were interviewed, exposing a range of opinions at the working and management levels but not constituting representative samples:

- the managers of 17 R&S projects (see Annex B);
- A. Aly, K. Pereira, M. Measures, I. Grant, P. Wigfull, J. Waddington (Directors and DG);
- J. Riznic (acting manager, R&S Program); B. Ghorbani (audit and evaluation).

In addition, the consultants looked at the experience of other federal government science-based organizations. Annex C contains short accounts of their current approaches to research planning and research performance measurement.

Finally, the consultants also attended a workshop on the current views of the Office of the Auditor General (OAG) on reporting results.

The consultants devised a structured interview guide (Annex A) to ensure that certain topics were discussed but not to prevent additional topics from entering the interview. Its purpose was to determine:

- What is done under the heading "Research and Support"? Is it successful in the eyes of those directly involved? How do they define success in these circumstances?
- What is the value of Research and Support spending for AECB? What is the impact on AECB? Is Research and Support being done in a manner that maximizes the benefits?
- How does AECB measure and report on success in Research and Support? How could measurement and reporting be improved?

The views of interviewees are interspersed throughout the report. There is a general consistency of views and outlook, at least among the 25 members interviewed. As one person noted, "We all know why AECB exists; we know why we are here. You don't find this level of shared sense of mission in most other federal government organizations." Moreover, there was a general willingness to try new approaches in order to improve performance.

C. BACKGROUND: AECB

AECB's style of nuclear industry regulation is different from that of other countries. Elsewhere, as in France and the U.S.A., the regulator is highly prescriptive and sometimes adversarial. The regulator in these cases has a large research budget; it has to work entirely independently of

licensees. AECB has a much smaller budget proportionally, and operates on a basis of 'common cause' with licensees—all participants in the nuclear domain want to have safe operations, and all understand that public suspicion of unsafe nuclear power is the biggest impediment to the long term success of this sector.

This study occurs at the end of a period of upheaval² due to reorganization throughout AECB (including the R&S function), and during the period when regulations were being written in preparation for proclamation of the new Act.

AECB has field representatives at major facilities. These officers are largely 'generalists.' Other technical officers (scientists and engineers) work in HQ—in two divisions that deal with the facilities operations; and in nine other HQ divisions that are discipline-based. It is in the discipline-oriented divisions that the issue of the adequacy of available knowledge must ultimately be faced. These are the divisions that have the greatest interest in research and 'research support.' All divisions may have a need for 'operational support.'

Before the reorganization, there was an autonomous Research and Support Division. Clients in other divisions would identify research or support needs, then help with writing terms of reference (TOR) and with hiring a contractor. Clients had little to do with managing research and support projects; this was the work of Research and Support Division. After completion of a project, the clients would receive the results.

Under the new Research and Support Program (RSP) setup, interested staff have to be proactive in proposing research activities. After approval in principle, a proponent then writes up the TOR, and initiates and manages the project. AECB no longer has positions for generic research managers. As a consequence, if an approved research project cannot commence or continue because the proponent is too busy with other duties, the project usually cannot be shifted to someone else with equivalent skills. Rather, the money has to be shifted to another project, or lapse.

The consultants were told that budget restrictions have reduced conference travel in recent years. This is regrettable because presenting results at conferences is important for AECB's credibility, and conferences help staff to keep up with their discipline. Conference proceedings are getting more expensive. However, there is an increasing amount of relevant information available on the Internet.

As mentioned earlier in this section, AECB works with the domestic nuclear industry. This includes research. Far more research is done by industry than by AECB. Sometimes there has been a planned collaborative approach; at other times, AECB has had a catalytic effect on

²Therefore, the high degree of R&S funding slippage was unusual and would not be expected in more 'normal' times.

industry's research spending. However, this relationship may be changing due to the new status of some of the largest licensees (e.g. privatization of Ontario Hydro) and concomitant uncertainty about the future of their research activities. (There is already some evidence of reduction of research budgets among licensees.)

AECB executives decided in 1998 to adopt performance measurement (PM) throughout the organization. Four PM pilots were initiated, the Research and Support Program being one of them. So far, a performance management framework (PMF) has been drafted by RSP with assistance from Audit and Evaluation. Using a perspective and vocabulary that have become common in the federal government in the 1990s, it suggests a "logic model" of processes, and expectations in terms of *resources, reach and results*; and proposes measures of performance aligned with that model.

D. BACKGROUND: PERFORMANCE MEASUREMENT IN OTHER SCIENCE BASED FEDERAL GOVERNMENT ORGANIZATIONS

Annex C contains brief accounts of the performance-measurement efforts of other federal government organizations in which scientific research plays an important role.

Generally, other organizations were curious to hear what AECB is doing. Only a few organizations appear to be ahead of AECB. More are beginning their explorations—and others have not even started.

At the finely-detailed level, there is no single model of how to measure the performance of a research program. However, there is a consensus on general principles. Some of these were summarized in a presentation by a senior OAG official in June³:

- The point of performance measurement is to understand what was accomplished—that is, the outcomes of program activity. Outcomes of programs in the public sector are complex. Measuring the inputs and the immediate outputs of a program or process is the easy part, but by itself it does not tell you if the outcomes are due to the program or process.
- Assessing nearer- and longer-term outcomes is not an exact science. It is realistic, however, to try to reduce uncertainty about outcomes and about what contributed to their occurrence.

³John Mayne, "Dealing with Attribution using Contribution Analysis," June 15, 1999. The bullets here quote or paraphrase Mr. Mayne and reflect some of the ensuing discussion.

- The planning of measurement begins with agreement on the vision and logic of a program. This can be difficult to achieve; often there are differing views within an organization on why a program exists, what it is intended to do and how.
- The next step is to achieve agreement on what ought to be measured in order to know how well you are doing.
- The final step of the planning is to decide which measures will be monitored on an ongoing basis, tied to program or activity cycles; and which will be covered in periodic evaluations. One may readily monitor for issues of efficiency (the relationship of inputs to outputs) and of short term effectiveness (immediate outcomes).
- The input-process-output relationship is largely or totally under the control of a program. On the other hand, outside factors have an influence on outcomes. The longer the term in which the outcomes appear, the greater the influence of outside factors. Thus, for 'ultimate impacts,' attribution of the contribution—the degree of causal influence—of the original program activities can be quite uncertain. One strives to construct an account of causal factors that would satisfy the average reasonable observer.

The following are highlights of the recent experience of other organizations:

- Incrementalism—there is a perfectionist tendency (especially among scientists and engineers) to wait until the ideal, intricate performance measurement instrument has been designed. It is better to get started sooner rather than later, with something basic, and refine it based on experience. For instance, NRC's Institute for Research in Construction is two years along into performance measurement. They are finding that ongoing monitoring of process (e.g. whether milestones are met) is relatively easy, as is end-of-year reporting of outputs. However, they feel that their longer-term measures, oriented to effectiveness, need further development.
- Case studies—there is wide interest in case studies (including at OAG) as a promising technique. Individually, they allow for complexity and subtlety in estimating the relative influences of many causal factors. Collectively, they allow for detection of common themes. They can suggest surrogates for direct measures.
- Typical measures—quantity and significance of practical recommendations from completed research; success in having results accepted by the scientific community (peer-reviewed journals, presentation at conferences); success in interesting other institutions to collaborate in present or follow-up research (partners may contribute financially or in-kind); expenditures on practical work (e.g. modifications to facilities) undertaken on the basis of research results; further research expenditures to follow up earlier results; client satisfaction with relevance of proposal; client confidence that results can be put to intended use.

- Return on investment is a significant measure that can take various guises including maintenance cost reductions and reduction of losses from suspended operations thanks to research results.
- Planning—there must be a careful, formal processes for identifying research needs. Plans should specify the knowledge gap, significance/risk, acceptable timetable and price.
- Operational focus—shorter term operational requirements predominate over longer-term exploration. Therefore some labs try to mix A-Base funding with fee-for-service resourcing.
- Time Constraints—operational-area clients have little time to integrate new information, so expanded knowledge capacity tends to remain with the researchers rather than transferring to the client organization.
- Ultimate effectiveness—for mission-oriented research (as opposed to curiosity-based research), effectiveness must link back ultimately to the fundamental mission of the organization which sponsors the research. As seen at Natural Resources Canada, measuring the performance of research requires measuring movement with respect to the department's fundamental business (such as 'Natural Resources Canada will exert a downward influence on energy consumption by Canadians'), and then determining the degree to which the department's research may have contributed to this movement. Because the phenomena in question are so long-term and complex, no direct measurement of the influence of the research is possible. Rather, the approach endorsed in recent studies for Environment Canada is to generate a comprehensive case study and seek the reactions of experts to it, asking them what percentage (if any) they think that the research program contributed to the final results, and what would have happened if the research had not been done.

E. A REVIEW OF RESEARCH AND SUPPORT PROJECTS COMPLETED IN 1998-99

Seventeen research and support projects representing a wide range of experience were selected for review. The consultants characterize these projects as follows (see Annex B for a more detailed description):

- 11 of the 17 projects were truly **research** projects, including field studies that verify or refine lab studies or theoretical models or apply them to Canadian conditions; studies that filled gaps in AECB's knowledge or advanced knowledge in the discipline worldwide;

studies that helped to close contentious issues: validation studies. While it was claimed that all research is conducted by outside contractors, one of the 11 projects was carried out by the AECB staff member: the contract paid a fee for his participation in an international collaborative experiment.

- Two other projects **advanced knowledge through interchange** among experts in Working Groups. (In other cases, WG participation and support come out of Section budgets, but these two came out of the R&S budget.)
- One project dealt with management issues in the area of research. While relevant to research, this was not research *per se* but **organizational development**.
- Three projects can be characterized as **operational support** as they carried out regular assessment work where AECB lacks the required internal expertise, where proprietary information was available to a contractor but not to AECB staff, or for workload reasons.

Based on interviews of the managers of 17 projects, the consultants found that, for these cases:

- The managers felt that the projects had been carried out professionally and that the results corresponded to the projects' terms of reference.
- In most cases, project managers had a clear idea of how the results would be used in the near or longer term.
- In most cases, project managers knew why the project had been initiated and why it was paid for out of the R&S budget. The exceptions arose around projects 'inherited' from the original proponent; and around instances of funding meetings of experts. Apart from these exceptions, the project managers were personally satisfied that their projects represented 'good value' for AECB.
- Project managers described the value of research or support in both discipline terms (filling gaps in knowledge or creating greater certainty in knowledge) and operational, mission-oriented terms (contributes to the knowledge we need for assessments or performs an assessment, contributes to the knowledge we need to write standards and guidelines, or writes a standard or guideline for us).
- There was no standard vocabulary for describing the value of research or support projects. For knowledge or discipline oriented projects (i.e. research in the normal sense), the responses matched closely the three objectives in the proposed "Performance Framework for Research and Support Program" (draft of April 20, 1999).⁴ These three objectives do

⁴These objectives are:

To support timely regulatory judgments and decisions through the acquisition of independent expertise, advice and information.

To assist the resolution of health, safety, security and environmental issues by developing capability and tools.

not, however, provide vocabulary to cover the projects which their managers and/or the consultants considered to be of an operational support nature (i.e. they performed an operational task without acquiring new knowledge for AECB).

- Project managers were generally not sure how the institution regarded their research or support activity—beyond the practical issue of gaining approval. The project managers think about their research or support contracts in terms of their own work and that of their Section: they do not see a linkage to a corporate strategy or ‘big picture’ beyond their own discipline and Section or division. (The directors interviewed spoke occasionally in more strategic terms, both general—for instance, ‘this helps us to keep our internal expertise up to date’—and specific, for instance by referring to the executive decision that AECB must document its assessment and decision criteria better.)
- The current Post-Project Evaluation (PPE) is a merely administrative “file-closing” exercise for project managers; it bears no value for its author or for the author’s colleagues.
- Project managers are generally satisfied with the sharing of results through internal seminars and AECB publications, although some advocate a greater emphasis on bringing results to the attention of a wider audience via scientific conferences and journals.
- Project managers reacted positively to many aspects of the proposed PMF. One area was met with scepticism, namely counts of copies of reports issued. Respondents feel that raw numbers are too crude and are subject to manipulation. Rather, each project has an intended audience: the proportion of the intended audience that is reached (by publications or presentations) is a better measure.⁵

Project managers repeatedly offered three general criticisms⁶ of the R&S activity:

- Limited funding. While all project managers agreed that their own projects were resourced adequately, many claim that the overall budget is too low to meet all significant needs. Too little research, they feel, is being done.
- Limited time. While the project managers interviewed felt that they had devoted sufficient time to managing their projects, they suggested that many colleagues have too little time to manage projects properly. In some cases, this deters staff from proposing

To assess the significance of emerging issues by performing exploratory studies.

⁵Interest outside the intended audience should also be noted. In some topic areas, for example, other countries like Sweden consider Canada to be leading the way thanks to AECB’s published research results.

⁶This study was not asked to assess funding levels. The issue of funding is included here because it is an element of the context in which AECB staff would measure the performance of R&S activities.

research, and in other cases, it prevents approved projects from getting started.

- Haphazard funding choices during the fiscal year. While the initial process of application and approval of R&S projects, before the start of the fiscal year, is careful and legitimate, this is not the case with respect to decisions on new commitments part way through the fiscal year when abandoned projects have freed up funds.

The consultants question several features of the R&S activity:

- AECB does not appear to have strategic priorities for research. Individual staff do not know if what they are proposing will be considered important to the corporate mission.

Recommendation E1: AECB should develop a research strategy and research priorities with a minimum five-year horizon. Senior management should communicate these priorities clearly to staff.

- The lifeblood of AECB is knowledgeable people. But only a few interviewees made some mention of knowledge creation and knowledge acquisition. Even fewer made any link to the human resources domain, e.g. the hiring and retention of specialists in key areas, and strategies for continual professional learning. The consultants feel that the research activity should be seen, in part, as an integral complement to other strategies (including HR strategies) for nurturing the pool of expertise available to AECB.
- Section Heads and Directors do not appear to be involved deeply in the research activity after the initial generation of proposals.⁷ This may result in opportunities being missed to derive more value from individual projects. It also suggests that the R&S budget is not seen by these managers as a Board-wide good that they hold in common (even if the accountable offices are essentially the RSP, the Research and Support Committee and individual project managers). The consultants feel that Section Heads and Directors should be actively involved in five ways: by
 - communicating AECB's research strategy and priorities to staff;
 - helping staff to generate proposals that reflect strategic priorities as well as short term challenges;
 - ensuring that approved projects get underway; this may require limiting the volume of other work for the project manager;
 - identifying funds quickly for de-commitment, if a project cannot be started or completed or if it is coming in under budget, so that other worthwhile work can commence; and
 - supporting the wide dissemination of research results to strengthen the available knowledge base.

⁷Based on interviews with project managers and with directors, not with section heads.

Recommendation E2: Section Heads and Directors should oversee the research and support activities in their own areas by helping staff to generate proposals in light of strategic priorities and to initiate, manage and follow-up approved projects.

Recommendation E3: Section Heads and Directors should act as co-stewards of the R&S budget by sharing information to ensure that funds neither lapse nor become allocated to secondary projects.

- There is no typology of research and support projects. A more detailed categorization of types of projects would help to highlight trends and would raise useful questions, for instance, whether a Section's professional services budget might be a more appropriate source of funding for a support project than the R&S budget.
- In cases where AECB relies on outside expertise that is not mirrored internally, it cannot judge the quality of the contract research or support results it receives. The consultants feel that AECB should regard this situation as a risk.
- It appears that support projects are quite different from research. Should the two categories of activity be resourced from the same budget? Is the time of the Research and Support Committee spent well in making choices about support?

F. TYPES OF RESEARCH AND SUPPORT ACTIVITY AND THEIR VALUE

Typology of research and support

What is "research" at AECB? What is "support"?

All interviewees agree—and corporate documents claim—that AECB research and support are mission-oriented; they apply to the mission and subject matter of AECB, namely regulating Canada's nuclear industry.

There is less agreement at the next level of specificity. Although there are documented⁸ definitions of "research" and "support," the consultants did not find that interviewees referred to them; nor was there a unified view of what these terms mean.

To be considered **research**, the consultants suggest that a project should aim at **increasing**

⁸See document 549108, file 34-0-8-0, 1997.11.03 concerning definitions of research and support proposed by RSC to the Executive Committee.

knowledge as one of its objectives. For instance, a research project would focus on one or more of the following:⁹

- discovery; advancing knowledge within a discipline;
- field verification or refinement of lab studies or theoretical models; validation;
- new application of general knowledge to Canadian conditions.

To be considered **research support**, the consultants suggest that a project should support either the planning and carrying out of research or the dissemination of knowledge; for example:

- interchange among discipline experts in domestic or international Working Groups;
- support for the organization by AECB of an international symposium.

Other support projects should be regarded as purely **operational support**, in that the projects focus on regular operational goals without adding to the fund of theoretical or applied knowledge pertinent to AECB's mission: for instance:

- engagement of independent experts to address issues raised by concerned citizens—to satisfy the political dimensions of the situation, the expertise must be external to AECB;
- development of job aids involving no new knowledge but an improvement in gathering and analyzing information;
- assessment assignments of the sort that internal staff would normally carry out if internal expertise was available at the right time, or if all proprietary information was available to AECB staff;
- assistance in document preparation;
- participation of contractors (or of staff of other agencies) in working groups led by AECB or in audits, appraisals or compliance inspections.¹⁰

Clearly, some of these instances of "Support" treat the R&S budget as an emergency 'professional services' fund. As one interviewee admitted, "It could just as easily have been paid from our Professional Services budget, which we control completely. But the right amount of money appeared in RSP at the right moment, so we got our project approved in February and completed by the end of March."

Recommendation F1: the 'support' element of R&S should be divided into research support and operational support.

⁹These points closely match the objectives of the draft PMF, cited earlier, which mentions the increase of knowledge in several ways: "independent expertise, advice and information," "developing capability," "exploratory studies."

¹⁰Some of these examples are from document 549108 cited in an earlier footnote.

Recommendation F2: Operational Support should be funded and managed separately from Research and Research Support.

The values of research and support: Why is research necessary at AECB?

Research and support activities add value to AECB in at least **four ways**.

The first, and key, value—and in general, the only value mentioned by interviewees—is to **generate new mission-oriented information**. The contribution made by research and support to the regulatory function directly or by applying the necessary scientific knowledge, is embodied in the proposed Objectives of the “Performance Framework for Research and Support Program” (April 20, 1999):

- to support timely regulatory judgments and decisions
- to assist the resolution of health, safety, security and environmental issues
- to assess the significance of emerging issues

This key value was echoed and amplified by many interviewees’ remarks on how research helps:

- to fill gaps in knowledge;
- to close contentious issues and to open new issues;
- to underpin the development of regulatory standards and guidelines (the new Act requires a new set of regulatory guides);
- to reduce risk;
- to provide an alternative viewpoint;
- to give reassurance and increase AECB credibility through independent corroboration.

However, the consultants suggest that **three other values** of R&S should be given the same prominence as new mission-oriented information. While overlapping with the above perspective, they provide an explicit *focus on people and organizations* through which ***knowledge is made available to AECB***.

Accordingly the second value of research is that it helps to **build internal knowledge, the expert capacity within AECB, by increasing the expertise of AECB staff**. It helps:

- to promote learning by AECB specialists; to help them keep up to date with their discipline; to promote knowledge transfer through exchanges with contractors and other experts:¹¹

¹¹As one interviewee said, “We are up-to-date when we are hired, but then we quickly fall behind; managing research helps us to keep up with our discipline.”

- to strengthen or supplement AECB's capacity to assess the scientific quality of reports or claims from industry.¹²

Third, research helps to **build available external knowledge in the form of networks of experts, the wider community of individuals and institutions that are ready to contribute knowledge pertinent to AECB's needs.** As some interviewees said, research helps:

- to enlist recognized experts into a wider 'virtual organization of experts,' beyond AECB itself, who are ready to supplement AECB's own efforts;
- to enlist promising young scientists and engineers into fields that are relevant to AECB's current and future needs;
- to give AECB options for meeting its requirements.¹³

Fourth, research helps to **build available external knowledge through research collaboration with other institutions and by influencing the research agendas of AECB's licensees.** As some interviewees said, research helps:

- to inspire research work by licensees (i.e. leverage, collaboration);
- to support domestic and international collaboration among regulators, industry and academic experts, so that far more knowledge is available to AECB than it could afford to acquire by itself.

The time frame within which the value of research is realized will vary. Research sometimes arises with an imminent regulatory matter in view; at other times, the application in inspection work and standards writing may be far off: "Our mission-oriented research helps us to take a licensing position. The research begins with a question related to a licensing decision. The question is not always clear. Often the usefulness of the results are not immediately apparent, but they build our knowledge. In-house expertise is a very long-range matter."

Recommendation F3: Research and Research Support should be planned and resources allocated in line with the following four objectives:

- ***to generate new mission-oriented information;***
- ***to build internal knowledge, the expert capacity within AECB;***
- ***to build available external knowledge in the form of networks of experts, the wider community of individuals and institutions that are ready to contribute knowledge pertinent to AECB's needs; and***
- ***to build available external knowledge through research collaboration with other institutions***

¹²As one interviewee said, "Sometimes it is suggested that we leave all research up to industry. Yet, much of our work is assessing reports for scientific validity. Therefore, we need to have our own independent opinion."

¹³"We don't have the skills and the time to cover every area we have to deal with. This is a knowledge organization. Either we produce the knowledge inside or get it outside. In some cases it is more economical and effective to rely on others outside."

and by influencing the research agendas of AECB's licensees.

G. WHAT MAKES RESEARCH AND SUPPORT CONTRACTS SUCCESSFUL

This section looks at the meaning of success in R&S activities. The next four sections deal with practices that make success likely.

Research and support for AECB are mission-oriented. R&S project results are mission-oriented—they are intended to help AECB staff to present scientifically sound and credible Board Member Documents every six weeks and to carry out inspection activities with the same soundness and credibility.

Most interviewees stressed the importance of proper planning of research: clear terms of reference (TOR); careful choice of the contractor; and thorough contact with the contractor early in the contract to ensure that the requirement is understood properly and to allow for an appropriate modification of the project if warranted.

Recommendation G1: project managers should formally confirm the terms of reference of a research or research support contract after initial meeting(s) with the contractor at which the TOR may be adjusted if necessary.

This leads to a criterion of success that was mentioned often—"success" means that the project met the objectives and conditions specified in the TOR (original or adjusted). That is, technical or scientific quality of results that address the stated problem, or satisfactory completion of agreed tasks in the case of support-oriented projects, is the crucial success consideration.

The project managers interviewed felt that the contract funds had been spent well in most cases. That is, TOR had been clear; there had been a good choice of contractor (indeed, some projects were delayed until the appropriate expert was available); initial meetings had allowed for learning on both sides and confirmation or adjustment of the TOR; and the work had been carried out professionally. In one case there was some dissatisfaction because the chosen contractor needed excessive time and help to understand the issues.

This perspective stresses the **direct output** of a research or support contract. Success is easy to determine in terms of results reflecting the confirmed TOR; quality of the work; adherence to timetable and budget; proper communications with client; and results reported in the agreed manner.

However, as the performance measurement and the "results based management" perspectives prescribe, one must look beyond direct outputs to utility in the near term and to longer term and

broader effects—nowadays called **direct outcomes**, **intermediate outcomes** and **ultimate impacts**. That is, the results of interest are not just the report in hand on the completion day of the contract, but how the information in that report contributes to the growth of knowledge available to AECB, to the effective operations (inspections, licensing decisions, new standards and guidelines, documentation of assessment criteria) based on that knowledge, and finally, to human and environmental security from the effects of radioactive isotopes.

In this larger perspective, some interviewees talked about research or support contracts being successful if they:

- “contribute to our needs on a particular issue:” this can occur immediately, or in 2 to 3 years, or even further off;
- “influence the way we do our business by building our body of knowledge:”
- incite licensees to make significant research or operational expenditures;
- earn recognition for AECB from other experts.

However, determining success at these levels is more complicated than for direct outputs. The measures need to address whether or not contract outputs can be used as intended in operations (inspections, assessments, guidelines); if they contribute to the growth of available knowledge within and outside AECB; and ultimately, if they are likely to have had a positive impact on AECB fulfilling its overall mission. That is, do they fulfill the AECB mandate in the manner suggested by the title of this study: “From Research Results through Available Knowledge to Board Decisions and Public Safety.”

H. ACHIEVING SUCCESS: PLANNING

Interviewees were split on the issue of research planning. Many of the project managers interviewed and some directors tend to focus on their particular discipline and its operational challenges: “In the Fall, the Section Heads prioritize with respect to regulatory needs, the problems of the day, and topics on which we feel uncomfortable.” Staff write up the ‘three paragraphs’ and proposals go to the Research and Support Committee (RSC) after signoff by the section head or director. On this scheme, priorities are internal to each discipline.

Other interviewees spoke at length about strategic planning, priority setting at the corporate level, follow through in terms of management systems, articulation of expectations, and tracking of results. Clearly, these are areas requiring concerted effort at AECB, and such effort has begun.

Senior management is not perceived as having priorities for research or as communicating them well. There is a need to define the “strategic contribution” of research. Without a strategy, there cannot be an integrated approach to research.

It is alleged that some staff do not always orient their research proposals to the corporate mission; they insist on 'doing their own thing.' Until research objectives and priorities are articulated, however, it is hard to impose discipline on idiosyncratic research agendas. (One interviewee claimed that middle managers "rely on the RSC to act as the heavy.")

Recommendation H1: research proposals that are inconsistent with AECB's research strategy and priorities should not be considered for funding without a credible case for special exemption.

It is alleged, further, that the Executive Committee and the Board do not express a demand for research results. Implicitly, whatever is there is fine; there is no guidance as to what would be preferable.

Recommendation H2: where relevant, Executive Committee and the Board should note the links between research results and their decisions.

The advantage of explicit research priorities and an overall strategy is that AECB can then judge its effectiveness and can argue coherently about issues such as funding levels for research versus operations.

The consultants suggest the following elements as candidates for inclusion in the strategic plan for research:

- research and support as mechanisms to address immediate operational needs;
- research to fill gaps in current internal expertise relative to present issues;
- research to fill gaps and accelerate knowledge growth internally relative to anticipated future issues;
- research and support to nurture external expert capacity that is available to supplement AECB's internal capacity;
- research to increase certainty and to reinforce credibility with licensees and interested parties;
- research to produce new information with respect to emerging issues in a discipline or to specific applications in the Canadian context;
- research to influence the agenda and research spending of licensees and other external bodies.

These elements constitute **expectations** against which to judge the effectiveness of completed R&S activities and of the overall R&S program. For example, they would lead AECB to estimate whether individual projects were exploiting opportunities to leverage the research agendas of licensees; or, they could allow AECB to show that the funding level overall is not sufficient for it to undertake projects with the primary purpose of increasing certainty and credibility, or of leveraging research by industry.

There are two planning issues of more immediate concern.

First, it is common for some projects to start late in the fiscal year and to carry over into the following fiscal year; and for some funds to lapse. RSP is addressing this problem and has set a target of 4% lapse for this fiscal year.¹⁴ RSP diagnoses the causes as (i) schedule slippages and (ii) inflated budgets for approved projects; in both cases, the invoices for work completed within the fiscal year will end up being lower than anticipated. Executive Committee has permitted RSP to over-commit at the start of the current fiscal year. This plus attention by managers at all levels to R&S monthly updates may remedy the problem. More generally, there needs to be a shared sense of stewardship for the R&S budget as a collective resource. Individuals, sections and divisions must be willing to raise the alarm as quickly as possible if it is anticipated that they will not be using R&S funds that were allocated to them.

Recommendation H3: project proponents, Section Heads and Directors should be required to signal potential slippage (i.e. inability to start or complete a project, or surplus at the end of a project) as early as possible.

There is a related question whether new funding decisions after the initial planning period (i.e. as funds are de-committed) should respect initial decisions on priorities among proposals. It would appear that some late-year approvals allow low-priority projects to slip in while higher priorities are 'waiting until next year.'

Recommendation H4: high-priority proposals that could not be funded at the start of the fiscal year should be the first candidates for funds freed up by slippage, without requiring a new application process.

Second, AECB needs to look at staffing levels and workloads in relation to the capacity to propose and manage research. Interviewees allege that some sections are swamped with work and cannot really devote time to managing research. Because there is no longer a central Research and Support Division, no one can manage the research for them. This is where the decision to decentralize research has had consequences that may need adjustment.

Recommendation H5: Sections and Divisions should include the capacity to propose and manage research within their HR plans.

¹⁴This is a very ambitious target, given that in 1998-99 the budget was reduced by \$200K in November and \$158K still lapsed; this total shortfall of \$358K represented a 17.7% lapse of the original budget of \$2.02M.

I. ACHIEVING SUCCESS: IMPLEMENTATION

According to the interviews with project managers, implementation of R&S contracts does not present any pattern of difficulties. Once initiated, projects have milestones and interim reporting requirements. These and other familiar features of project management allow the managers to monitor progress and deal with problems in a timely manner.¹⁵

Those interviewed thought that the financial commitment and time devoted were adequate on both sides—AECB and the contractor. A few interviewees mentioned initial meetings with contractors at which terms of reference are reviewed and either confirmed as written or modified. The consultants feel that this is an excellent practice.

At present, section heads and directors have no role during a research project except if problems are brought to their attention. The monthly RSP funding picture is distributed to directors, providing early warning of schedule slippage; but, it is alleged, directors may not see these reports amid the other items requiring their attention.

The consultants suggest that section heads and directors could contribute to successful implementation of R&S by:

- encouraging and supporting timely initiation of projects, i.e. shortening the time from approval in principle through writing detailed TOR and having them approved, to engagement of a contractor;
- ensuring that a project manager has adequate time to fulfil this role;
- planning with the project manager for the knowledge dissemination and other aspects of post-completion follow-up (see the next section);
- reacting speedily when it is evident that an approved project may not be able to start or to use its entire commitment of funds. (If a high priority project within the same discipline area had the 'first rights' to these funds, there might be a strong motivation to deal with these situations alertly.)

One Division uses the time reporting system to track the time required for R&S purposes, down to the individual project. This is a good management tool if staff cooperate with the system and

¹⁵ There is no AECB standard for project management, but project management training has been offered recently. The trainer also conducted a study "...on Project Management Capabilities Using NAOP as a Case Study" (file 34-2-545-1), as one of the R&S projects in 1998-99. Its recommendation stress (among others things) the need for strategic planning; for consistency in terminology and key processes; and for communications. Communicating during planning links a project to the strategic plans; during project operations, it facilitates resource management; and at the end of a project, it links outputs to objectives, allowing the organization to judge the project's value. All these points are consistent with the findings of the present study. Good project management and good performance measurement are mutually supportive.

the database is properly maintained.

Recommendation 11: Sections and Divisions should use the time reporting system to track the time invested in managing research projects.

J. ACHIEVING SUCCESS: FOLLOW-UP

The interviewed managers were quite satisfied with the immediate follow-up process for completed projects. Such follow-up typically had two elements: a seminar by the contractor and a written report available within AECB and to the public. The project managers were also of the view that the planned operational outcomes would be achieved. An example of such an outcome is the provision of input to a licensing decision or a guideline.

Some interviewees feel that the knowledge dissemination activities should be more extensive.¹⁶ For instance, there could be more emphasis on exposing results in scientific journals and conferences.¹⁷ This would have resource implications in terms of time for such activities and related expenses.

Recommendation 11: AECB should support greater proactive sharing of research results with experts outside AECB.

In a few instances, interviewees spoke of longer-term planned outcomes and impacts: for example, using research to provide the lone AECB expert in a new specialty with virtual colleagues (for professional discussion and to share the workload); or using a small project as a demonstration in order to stimulate a much larger project of the same sort by industry. As the objectives and priorities for R&S become articulated, it should become easier to plan for and track this type of follow-up as well.

K. DOCUMENTING SUCCESS

As AECB has realized, the current approach to documenting the effectiveness of R&S activities is inadequate.

The present approach produces credible information on such features as adherence to timetables

¹⁶The balance of this section pertains more to research and research support than to operational support projects

¹⁷One project manager said that "Publishing results and giving seminars within and outside AECB, getting feedback from colleagues—these are relevant ways of completing the project."

and budgets; numbers and sizes of projects approved/ initiated/ completed; and receipt of outputs (i.e. written reports and staff seminars) that show that projects fulfilled their TOR. This is supplemented with speculative information on intended future use of results.

Some of this information is presented in the PPE. There is no evident use of the PPE. Indeed, it is alleged that late or missing PPEs are ignored. Project managers generally feel that the PPE is a "close the file" exercise, a merely administrative exercise with no decision-making or other tangible benefit. Some were not sure if anyone reads the PPE other than the RSP Manager. They certainly felt that the PPE does not 'tell the whole story' about the significance of the research that was completed.

Project managers and other interviewees generally agreed that longer-term follow-up of results is needed. While the measures of efficiency and process are still important, there should be more information on effectiveness. Some would be readily available: for example, bibliographical references would show whether or not results had been used in later assessment work and standards development.

In general, interviewees reacted positively to the proposed PMF—at least it improves on the PPE. There were suggestions that some measures are more important than others and that Finance officers might be in a better position than project managers to supply some of the information. Moreover, AECB should allow itself to use more contextual measurement (for example, case studies) to allow for the complexity of attributing long-term effects to particular research results. AECB needs to avoid a naive and cumbersome PMF that puts too much emphasis on easily gathered quantitative information.

Recommendation K1: the Post-Project Evaluation should be integrated into the performance measurement activities proposed in this study.

L. PROCESS MODEL

The organizing framework for setting out performance measures is the following 14-stage **process model** for conducting AECB's contract research and support activities:¹⁸

¹⁸To simplify matters, the model does not contain the steps required to approve and initiate new projects after the start of the fiscal year to take advantage of de-committed funds.

1. Setting the corporate strategic objectives and priorities of research
➡
2. Identifying research needs and priorities in disciplines and sub-programs
➡
3. Preparing and presenting proposals
➡
4. Negotiation of the R&S budget between RSC and the Executive Committee
➡
5. Gaining approval in principle
➡
6. Writing detailed Terms of Reference
➡
7. Gaining go-ahead approval
➡
8. Selecting contractors
➡
9. Confirming TOR (after adjusting if needed in initial meetings with contractor)
➡
10. Monitoring of research as it is being carried out: interim payments to contractor
➡
11. Acceptance of *outputs* of completed research (successful seminar, appropriate final report); final payment to contractor
➡
12. Tracking *direct outcomes*, the use of results for short term operations and knowledge sharing
➡
13. Assessing *intermediate outcomes*, the use of results in the medium term
➡
14. Estimating the long term influence or *ultimate impact* of results

This model incorporates the present process, which is well established and largely satisfactory from the point of "identifying research needs and priorities in disciplines and sub-programs" (Stage 2) to "acceptance of *outputs* of completed research (successful seminar, appropriate final report), and final payment to contractor" (Stage 11).

The present process needs to be supplemented or strengthened at the front and back ends. At the start, AECB needs to "set the corporate strategic objectives and priorities of research" (Stage 1). After completion of a contract, AECB needs to:

- track *direct outcomes*, the use of results for short term operations and knowledge sharing (Stage 12);
- assess *intermediate outcomes*, the use of results in the medium term (Stage 13)
- estimate the long term influence or *ultimate impact* of results (Stage 14)

The logical tie-back of results is

- from direct outcomes (Stage 12) to the needs and priorities of the disciplines and sub-programs (stage 2);
- from intermediate outcomes (Stage 13) to the AECB strategy and priorities for research (Stage 1); and
- from ultimate impacts (Stage 14) to AECB's overall mandate and business goals.

These tie-backs are reflected in the performance measures recommended in the next three Sections of this study.

Recommendation L1: the R&S Process Model should be clarified and communicated to staff.

M. PERFORMANCE MEASURES OF PROCESS, OUTPUTS AND DIRECT OUTCOMES

These measures focus on Stages 5 through 12 of the process model.¹⁹

Some of these measures require that research or support proposals (Stage 3) indicate their projected start date; the intended audiences for seminars and reports; and the intended utilization of results in the short term after project completion, for operational uses, knowledge transfer, or both.

Recommendation M1: research and research support proposals should be as detailed as possible with respect to intended start date, dissemination of results, and initial utilization of results.

Five forms of reporting of these performance measurers are needed:

- A. Project manager's report on individual completed project, to 'output' point (Stage 11).
- B. Project proponent's report on individual abandoned project.
- C. RSP summary report of the above information, from all completed and abandoned projects.
- D. Project manager's report on direct outcomes (Stage 12) of individual completed project.
- E. RSP summary report on direct outcomes (Stage 12) of all completed projects.

¹⁹As mentioned earlier, the draft PMF contains much useful material that is reflected in this and the following two Sections. However, it is misleading in two areas. "Co-deliverers" should be considered under the heading of *resources* like other deliverers (i.e. internal staff, contractors), not as part of the *reach*. Second, "outputs" should be looked upon as the most immediate *results*, rather than as part of *resources*.

A. Project manager's report on individual completed project, to 'output' point (Stage 11).

A completed project is one that reaches the point of transfer of agreed outputs from contractor to client, resulting in final payment (i.e., Stage 11).

The project manager should provide a **process and output report** within three months after project completion. It should include information on the following performance areas:

- final expenditure in absolute terms and as percentage of approved (Stage 5) and confirmed (Stage 9) budget, with explanation of any deviations;
- adjustments to TOR if any, and why (Stage 9);
- direct costs of managing the contract (project manager time, travel expenses etc.);
- adherence to milestones and completion date;
- technical quality of results (4-point scale of *exceeds expectations, meets expectations, fair, poor*);²⁰
- quality of seminar (4-point scale as above);
- quality of report (4-point scale as above);
- relationships (communication, cooperation etc.) between contractor and client (4-point scale as above);
- proportion of intended audience reached by seminar (scale of *none or minimal; at least 25%; at least 50%; at least 75%; all*);
- proportion of intended audience receiving report (scale as above);
- collaboration: nature and amount of participation in the project by other partners, and the influence this had on the project.

Recommendation M2: the manager of a completed research or research support project should report on key elements of the process followed and on outputs within three months of project completion. The process elements include financial, schedule and communications performance measures. The output elements include fulfilment of terms of reference, quality of results and reporting, proportions of intended audiences reached, and collaboration.

B. Project proponent's report on individual abandoned project.

For every project that was approved (Stage 5) but did not reach final outputs (Stage 11), the project proponent should provide a **process report on an abandoned project** approximately three months after the project is abandoned. It should include the information as above for those stages that were completed, and identify where and why the project was abandoned. (This does not apply to projects continuing into the next fiscal year.)

²⁰This scale is used by CANMET (NRCan).

Recommendation M3: the proponent/manager of an approved but abandoned research or research support project should report on the circumstances within three months of its abandonment.

C. RSP summary report on all completed and abandoned projects.

By late summer, based on the individual reports on completed or abandoned projects, the Manager of RSP should complete a 'roll-up' **process and output report on completed and abandoned projects** that includes information on:

- budget as planned (Stage 5), committed (Stage 7) and expended (Stage 11);
- adherence to time-frames—delays in start-up, delays in completion, number of projects carrying over into the next fiscal year, budget required to cover carry-overs;
- overall success in reaching intended audiences for seminars and reports (Stage 11);
- analysis of abandoned projects (at which stage, why).

Recommendation M4: the RSP Manager should produce a report on process and output issues for completed and abandoned projects within five months of the end of the fiscal year, based on the individual reports of project managers or proponents.

D. Project manager's report on direct outcomes (Stage 12) of individual completed project.

A completed project (Stage 11) has outputs (in terms of a seminar and a written report) that have been accepted. This is the minimal result. The first level of effectiveness is reached if these outputs can be used as intended in the near term, i.e. in **direct outcomes**. Of course, 'near term' cannot be defined as an absolute length of time. The project proposal should set out how soon such outcomes could be expected (see Recommendation M1).

The project manager of a completed project should produce a **direct outcomes report** approximately nine months after project completion. It should include information on:

- use of the results in intended operations (that is, inspections, development of tools and methods, assessments, decisions, new guidelines and standards);
- dissemination of results (for instance, through conferences, peer-reviewed journal articles, provision of paper and electronic copies).

Recommendation M5: the manager of a completed research or research support project should do a report on its direct outcomes approximately nine months after completion of the project, or later if the direct outcomes are still anticipated.

E. RSP summary report on direct outcomes (Stage 12) of all completed projects.

Based on the individual direct-outcomes reports, the Manager of RSP should complete a **summary report on direct outcomes**. This should provide a good indication to RSC and Executive Committee of the tangible results of the R&S activity.

Recommendation M6: the RSP Manager should do an annual summary report on direct outcomes of completed projects, based on the individual reports of project managers.

N. PERFORMANCE MEASURES: INTERMEDIATE OUTCOMES

The performance measures below are intended to show the effectiveness of research and research support activities in the medium and longer term—not a predictable or uniform length of time—with respect to new mission-oriented information, building expertise inside and outside AECB, and leverage and collaboration.

The measures should include:

- conventional 'knowledge creation' evidence—new titles, citations;
- dissemination of information—numbers of paper copies, numbers of electronic 'hits,' size of presentation audiences; by population type (academic, interested citizens, industry etc.);
- use of results to develop AECB's research agenda;
- growth of collaborative arrangements (research partnerships, research collaboration agendas etc.) with respect to the topic; use of results in establishing links with other departments, provinces, international organizations;
- leverage of research spending by other organizations—this may be quantified in a 'return on investment' manner;²¹
- connections between R&S activity and development of internal expert capacity—
influence on recruitment, means of 'keeping up to date,' support to small staff in a new topic area, etc.;
- connections between R&S activity and cultivation of external expert capacity—use of outside experts to explore new topics, provision of independent corroboration by outside experts, etc.;

²¹For instance, AECB's scale model reactor project stimulated creation of a full size fluid reactor research facility by industry.

- use of results in closing contentious issues and in opening new issues:²²
- trends in challenges to AECB positions in which adequacy of scientific information plays a role;
- influence of research results on AECB regulations and other positions:²³
- feedback from the Board—level of satisfaction with the scientific soundness and credibility of staff recommendations.

The consultants suggest that such a reflection should take place twice a year within each sub-program and each Section or Division and should be reported once per year. These outcomes are matters of group, not individual, responsibility. Moreover, making this the topic of a semi-annual meeting within each group will promote the sharing of research results and the extraction of greater value from them. The resulting reports should go to senior management and to the RSC.

Recommendation N1: project managers and their colleagues in sub-programs, sections or divisions should report annually to senior management and RSC on the intermediate outcomes of research and research support activities. The number of years past that the reports cover will vary with the nature of the discipline and its research/ research support history.

O. PERFORMANCE MEASURES: ULTIMATE IMPACTS

The draft PMF suggests two excellent performance measures of ultimate impact, focusing on “correct and defensible licensing decisions” and “confidence in regulations.” That is, AECB should look for the ultimate impact of its R&S activities in the:

- Existence of documented, credible technical studies in place that have stood the test of time, forming a base for confidence in regulations.
- Existence of information, tools and expertise to recommend correct and defensible licensing decisions.

“Expertise” in the latter measure is to be understood as the availability of experts, both inside and

²²Closing a contentious issue is a management decision (for example, management may resolve to commit more resources or less resources to an issue, now that it is more clearly understood) that can be based on research results as well as other factors. Similarly, opening a new issue (for example, management may name a new research priority for several years) is a management decision.

²³This may also be quantified in a ‘return on investment’ manner. For example, about \$500K of research for AECB resulted in adjustments by industry valued at \$30M to \$40M. In a similar vein, savings by industry could be quantified in instances where revised regulations or procedures allow for industry to shorten down-time without increasing risk.

outside AECB, to meet AECB's operational needs.

The consultants suggest adding two more measures. One of them pertains to the future orientation of research:

- Existence of an AECB research strategy, reflecting AECB's strategic priorities and a risk assessment of knowledge gaps, for five years forward from the present.

Such a research strategy would be an outgrowth of the past research results. It would show that past results had been used to reflect on the state of knowledge available to AECB and on further research options to meet its highest priority knowledge needs.

The final and most important measure of the effectiveness of the R&S activity is whether, over a multi-year duration, it helps AECB to reach its fundamental goals:

- Contribution of AECB's contracted research and support activities to achieving its core mission and business goals.

Recommendation O1: AECB should estimate the ultimate impact of research and research support in the following terms:

- *existence of documented, credible technical studies in place that have stood the test of time, forming a base for confidence in regulations;*
- *existence of information, tools and expertise (internal and external) to recommend correct and defensible licensing decisions;*
- *existence of an AECB research strategy, reflecting AECB's strategic priorities and a risk assessment of knowledge gaps, for five years forward from the present; and*
- *contribution of AECB's contracted research and support activities to achieving its core mission and business goals.*

This assumes that AECB can define its ultimate goals in measurable terms. To do so requires development of one or more comprehensive indices. While this question is outside the scope of the current study, here are a few illustrative suggestions of what such an index could look like:

- reductions in numbers of minor incidents and in the consequences of minor incidents relative to overall volume of activity in the regulated sector;
- continued absence of major incidents, contrasted with an index showing changes in the complexity of challenges being faced (e.g. older plant, stricter environmental demands);
- state of readiness for decommissioning;
- state of readiness for disposal of wastes;
- improved down-time efficiencies without increasing risk.

Recommendation O2: AECB should develop high-level indices of its performance against its mandate and business goals.

Assessing the ultimate impacts of R&S will be a matter for periodic evaluation, not continual monitoring. Evaluation design is also beyond the scope of the present study; however, the following points hint at the possible elements of such an evaluation:

- AECB business performance during the evaluation period with respect to the comprehensive index or indices chosen;
- logic model for the part that the R&S activity plays, among other factors, in achieving ultimate business goals: note that the process model is not the same thing as a logic model;
- key environmental issues (new legislation, privatized industry, changing patterns of research among collaborator institutions and licensees, aging physical plant etc.);
- how operational and knowledge risks were assessed over the evaluation period relative to these issues;
- research priorities in this period by discipline or sub-program;
- how each discipline or sub-program grew its fund of information, its internal expertise, its network of outside expertise, and its collaborative relationships in this period.

Recommendation O3: AECB should develop a logic model of the influence of research and research support activities on the attainment of business results.

Recommendation O4: AECB should develop an evaluation framework for evaluating the ultimate impact of its research and research support activities in anticipation of such an evaluation three years after confirmation of its first research strategy.

P. CASE STUDIES

There is a growing recognition, at OAG and in various science-based organizations, that quantitative measures are inadequate to tell the story of the effectiveness of research activities. In addition to the reporting done by project managers and the RSP manager, AECB should ensure that significant research activities are written up as case studies. The style should be interesting to lay readers. The case studies or stories should be summarized in the AECB Annual Report,²⁴ and used in other communications that explain the value of AECB's research and support activities.

Recommendation P1: AECB should review and promote its research activities by means of case studies.

²⁴The 1997-1998 Annual Report gives a purely administrative overview of the R&S activity; there is no way of telling that R&S, which represented nearly one third of Professional and Special Services expenditures, added anything of importance to AECB's achievements.

Annex A: Interview Guide

Why we are interviewing you: To get a sense of the research project managers' views of the value and success of their projects; and to test a framework for performance measurement in the research area.

Who is your section head/ director? (important for following up on corporate usage, and on responsibilities for reporting performance)

1. In general, what value or values does research have for AECB (research managed by others as well as by you)? How do you think of success in research projects?

2. Was **this** project truly research? Of what sort? [Hints: full-fledged expert for independent opinion or to develop new knowledge; subordinate level assistance; exploratory]

If not research, then what was it? [Hints: support (expert help with on-site inspection, expert assessment of submission from licensee), learning, other]

2.A. Why did you propose **this** project? What is the issue that it addresses and why is it important? Would something else have been a better candidate for funding? When was it approved—at the start of the cycle or later when uncommitted funds became available?

3. Was this project properly resourced—by AECB (in terms of the \$\$ allocated and of the time available to you and anyone else involved), and by the contractor? Was it done on time?

3.A. If this project carried over from the previous year, why did that happen?

3.B. Have you ever been in a situation of lapsing research funds?

4. Do you think this project was successful? On what criteria? In what sort of time frame?

5. How does it contribute to the work of your section or division or AECB?

5.A. Did this project involve collaboration with other sections of AECB? With licensees? With international partners? What is your experience with such collaboration generally?

6. Review the PPE for the project with the interviewee: is it accurate, does it tell the whole story, does it give the really important information? Is this captured in the PPE, or is it an issue for a different venue?

7. What is your role as a research project manager? How does that role relate to the roles of others? (peers, supervisor, section head, director, RSP, committee)

8. The research proposal sets out the expected uses of results. then the PPE enunciates the results and their projected usage. That usage would probably occur some time later. Suppose you were asked to check whether the projected usage actually occurred. and suppose you had to describe it. Where would you look for evidence and how would you describe the impact?

9. In fact, a framework has been drafted to permit staff to describe the performance of research activities in terms of direct outcomes and ultimate impacts. Thinking of what you said before about the success and value of this project, please go through the draft performance measurement framework with me and comment:

- are the criteria or information types relevant to measuring the performance of research activities?
- would it be feasible for you to provide this information? Is the required information accessible to you?
- would going through this exercise enhance the quality of the research activity?

10. Questions about previous research. If you managed previous projects.

- were they successful?
- when did you know they were successful?
- how did you know they were successful?

11. How does AECB (and you yourself) keep up with knowledge in relevant fields?

12. How does AECB (and you yourself) capture and use/ retain and share knowledge in relevant fields? (nb. retirement)

Annex B: Review of 17 Research and Support Projects—Types of Projects

We felt that 11 of the 17 projects examined were truly **research** projects. Some grouping into 'types' is possible:

- field studies that verify or refine lab studies or theoretical models, particularly with respect to the unique geological and other conditions of AECB's licensees (Bottomley, Nguyen)
- studies that filled gaps in knowledge or advanced knowledge (Theriault assay, Tougas, Harrison, Belfadhel, Thompson, Thompson/Munger, Majola)
- studies that close contentious issues (Serghiuta)
- validation studies (Rzentkowski)

One of these research projects was significantly different from the others. DECOVALEX involved paying a fee to participate in the planning of a collaborative field test, to take part in one or two workshops per year, and to guarantee the opportunity to participate in the test itself. In this case, the researcher was actually an AECB employee, and the contract was more in the nature of a membership fee. Thus, the DECOVALEX expenditure had as its impact, the advancement of the knowledge of AECB staff via hands-on research. Yet it was also research in the standard sense, since the field test aimed to verify lab studies or theoretical models.

Two other projects advanced knowledge through interchange among experts (Poirier, Theriault work group). This tends to lead to fruitful planning and sharing of research. Therefore, we are inclined to agree on its importance, but there appears to be an anomaly in that other work group participation and support come out of Section budgets, but these came out of the R&S budget.

One project dealt with management issues in the area of research (Webster). While relevant to research, this was not research *per se* but organizational development. Organizations normally pay for these services from their regular budgets.

Three projects of a support nature were to carry out regular assessment work:

- assessment assistance in cases where AECB does not have the requisite expertise internally (Schaubel);
- assessment assistance in cases where AECB does not have access to proprietary information needed to do the assessment (White); the Board has indicated that it will insist on full disclosure;
- supplementary inspection staff, i.e. assessment assistance where workload is too heavy for internal assessors (Lojk); in one case, where the R&S budget was used repeatedly to carry out assessments of licensees' training programs, the client has agreed to fund future assessments from its own salary and professional services budgets.

Annex C: Performance Measurement Experience of Other Federal Government Science-Based Institutions

Agriculture and AgriFood Canada

Bruce Mitchell, DG, Research Planning and Coordination, 759-7792

Not doing performance measurement yet but moving that way. Pragmatic research but not comparable to regulatory purpose.

They plan research engagements on two basic foundations: (1) public good, which contains 'soft' ideas plus return-on-investment (economic benefits) data; (2) partnerships with private sector interests willing to pay 50% or more of the research. Ongoing research as well as proposals are reviewed annually on the basis of these considerations.

There is pressure, ultimately from the need to report to Parliament, to be able to demonstrate the impact of their research better. The DM has established a business planning framework. The research areas will be expected to establish targets and then report against those targets.

They are just beginning an exercise to develop performance measurement on Montague results-reach-resources lines.

Canadian Food Inspection Agency

Shane Renwick, Science and Technology Unit, Science Division: 228-6698-1-5965
(works for Dr. Anne Fraser 228-6696-1-4135, referral from Bruce Mitchell at Agriculture.)

So far they have planning, tracking and review processes, no performance measurement. Program-driven research with regulatory purpose.

Science and Technology Unit coordinates between 20 internal labs and the CFIA program areas which are the clients for the research results, re inspection methods, animal health and plant health. Co-location of labs and inspection programs stems from early 1950s crisis where Food Production and Inspection Branch needed science support faster.

Planning pattern: programs areas define their needs and priorities, scientists may advise or suggest; programs comply with a formal needs-identification process, which creates the basis for reviewing priorities and for evaluating outcomes

Review pattern: scientific merit (peer review) and continued relevance (discuss with program

clients) every 6 months: final reports required within 6 months of project completion.

Project-specific management: tracking only, no performance measurement. However, "If projects aren't solving problems over a few years, we hear about it."

Communications Research Centre (CRC) - Terrestrial Wireless Systems Branch

Gerry Chan, VP, Terrestrial Wireless Systems Branch, 998-4139: interview reflects his previous role on the client side as well as his current work.

Matured process—research is planned and monitored and outputs are exposed jointly by the research provider and the client area; usage of research (i.e. outcome, impact) is in the hands of the client area, but is also seen in the expert advice given by researchers. Drawbacks—clients too busy on day-to-day work to build their own knowledge and appreciate the value of the research findings.

Spectrum Management Sector (IC) is the client. Terrestrial Wireless Systems Branch (TWS) of CRC is the research provider. Research budget (\$2.2M in 1991, 750K now) is set and provided by the client, and supports 20 to 30 projects per year of a short- to medium-term nature. TWS also has A-Base funds from which it supports long term research. It also has other clients such as DND that pay for contract research.

Dual role: (1) TWS provides advice on S&T trends, regulatory or standards issues etc.; the researchers have a longer term view than the SMS staff; (2) TWS conducts the research.

Research management process has been refined since inception in 1991:

1. Spectrum Research Working Group made up of TWS and SMS representatives determines topics for research.
2. TWS develops specific proposals, submits them to SMS. Submission usually exceeds available budget.
3. SMS adjusts priorities, decides budget, approves surviving projects.
4. WG and Task Groups representing both sides monitor ongoing research 2x or 3x per year.
5. Seminars at end of year to expose results to TWS and SMS personnel.
6. Research reports are very short (down to one page unless client asks for more detail) in order to increase likelihood of results being read.

"It is up to our clients how they will use the results" in writing standards and regulations, or in changing techniques and equipment in spectrum management field work (finding illegal transmitters, eliminating interference sources etc.).

Weak points:

- inadequate funding given by the client to short- and medium-term research, given the breadth of

the issues:

- client area staff have too little time to really take advantage of the results via their own learning and by integrating them fully into operational work. Nevertheless, the benefits are not lost: the advances in knowledge influence the advice that researchers can give, and the report on the shelf may be read some time later by the client.

Communications Research Centre (CRC) - Broadcast Technology Branch

Metun Akgun, VP Broadcast Technology Branch (BTB), 998-2754

Research supplier to regulatory client (and others). Scientific quality and client satisfaction are key measures for short- and medium-term research.

Half the budget is from A-Base and half from clients.

BTB has two categories of clients, government (the Spectrum Management Engineering Branch at IC) and industry (makers of broadcast equipment).

Research work has to be scientifically sound—publication of results in well-refereed journals is an indicator of scientific quality. It must also meet the client's needs—repeat business and client saying "You did answer our questions" are indicators..

Long term research is funded from BTB's A-Base. "We ourselves make educated guesses about what the future hot issues will be." Sometimes very successful, for instance, thanks to earlier research on spectrum sharing between different types of stations, BTB was able to support the Department when DTH (direct-to-home) transmission began: Canada led in international fora on preventing degradation of services. Clients will not pay for long-term, visionary, unpopular research: that's where the A-Base is necessary. (Note: NRC's A-Base is anchored in legislation, BTB's is at the discretion of IC.)

George Teather is reviewing BTB research and doing a performance measurement framework; draft expected end of June 1999.

NRC

Jack Smith (audit, evaluation, performance assessment) indicates that they are progressing in performance measurement. See NRC 97-98 Performance Report—lots of hints for possible measures. See also CCMD work (Maurice Demers, 947-3683.) Need macro indicators more than micro. "We are less governmental" than other labs; more interest in economic impacts, less concern about public policy dimensions. Big question re Institute for Research in Construction: given its mandates re industry and re building codes, which changes, over several years, are

attributable to research? Answer from a broad assessment: it costs a few \$M per year to maintain, the economic impact is far greater: AECB would be the same. AECL anecdote: having materials research capacity allowed them to solve a Pickering problem in a few days rather than a few weeks. "The full life cycle of their research program—25 years—had a lower price tag than the cost of the down time that Pickering avoided." NRC anecdote: having a strong marine biology capacity allowed NRC to solve the tainted mussel problem in a few days, thus saving the PEI shellfish industry and related food-business sectors.

Bob Bowen, Director, Institute for Research in Construction (993-9503)

Research is driven both by industry needs and by regulatory concerns. Performance measurement has been instituted and needs refinement—attribution is questionable outside of case studies, and they need to find measures that allow for useful ongoing monitoring.

Two mandates—produce the model national building, fire and energy codes; and research re regulatory and industry needs (e.g. evaluate new products). Lots of work in consortia with industry; research is both industry and regulatory-mandate driven. NB: building code changes are not based directly on their own research; rather, it may lead to an industry council taking a position which is then proposed to the appropriate national code committee.

They are two years along into performance measurement. Finding that ongoing monitoring is more difficult than end-of-year performance report against gross measures. Process and outputs against plan is easy. Rather, need an overall framework (logic model), and indicators that will allow monitoring against the framework.

Quantifiable metrics are very difficult in public health and safety. The time from research to ultimate impact is too long and there are too many other factors, therefore strict attribution is not really possible.

Rather, **case studies** are a helpful device. They allow for complexity and subtlety in attribution, and they can suggest surrogates for direct measures. For example: success in creating research consortia with industry (if they think it is worthless they won't join); follow-up consortia projects (often structured to bridge between the regulatory perspective and the market-place objectives of industry) (if the research wasn't good, industry would not follow up).

Since they develop the national building code model which provinces and territories are encouraged to emulate, some of the measures are adoption of ICR positions by provinces without change; and movement by provinces towards the national model.

Chris Norris (993-0125) is responsible for the performance measurement effort. (left message)

Fisheries and Oceans

Nicole Asselin, Corporate Review Officer, 990-0170: provided draft of report on performance measures in science sector

Go slowly on performance measurement.

Advice: Scientists are willing to manage research better and work on proper measurement. However, there is a tendency to wait until the perfect instrument has been designed, and to create a very intricate instrument. It is better to get started sooner rather than later, with something basic, and refine it based on experience.

Agrees that case studies are a promising technique. Individually, they allow tenuous attribution in a complex situation to be portrayed fairly. Collectively, they allow for detection of common themes.

RCMP

Brian Joynt, Chief Scientific Officer, 993-0986

Small R&D budget. Research is planned with operational priorities in mind. Completed projects are exposed in scientific journals and conferences, and they must provide firm recommendations. Overall the work of the Labs has to stand up in Court.

The RCMP Labs are organized into seven disciplines. Most of the work is forensic operations support; there is very little R&D.

R&D proposals are planned within each discipline (a committee of its chief scientist and several lab representatives), then passed to the Chief Scientific Officer and then the Director for final decision based on the prioritization, significance for forensic science, and clear milestones and overall budget.

Because of budget limits, research often requires voluntary overtime and depends on loaned or donated equipment. (Manufacturers are highly motivated to provide new equipment for assessment; a positive review from RCMP Labs is good for marketing, and they see the assessment as a necessary step towards sales.)

There is no formalized performance measurement of the completed research as such. However, each completed project must have recommendations (for instance, whether the research confirms the existing forensic method or suggests that the method be replaced). Further, results are published and/or presented at conferences.

The ultimate effectiveness test is in the Courts. The work of the Labs has to stand up under cross-examination.

Industry Canada/ Industry Portfolio

Bob McDonald, Audit and Evaluation.

Various member institutions in the Industry Portfolio are trying to come up with a common approach to S&T performance monitoring and measurement. The work so far opts for four broad result areas and for reporting against strategic objectives.

Industry Canada is one of thirteen entities in the Industry Portfolio. The S&T MCIP (Management Committee Industry Portfolio) was established in 1996 after IC completed an S&T Action Plan—a roll-up of individual program plans (elements) from entity members. It began with 43 elements and has increased to about 56. The Action Plan makes no pretense of including all S&T in the thirteen entities or even in IC.

All of the portfolio entities are members of the S&T MCIP but only some are active (e.g. Space Agency; NRC; IC). The MCIP created a Sub-Committee for evaluation and for performance measurement. The sub-committee is tasked with the development of an approach for measuring program performance including monitoring of outputs and evaluating outcomes. The focus for their approach is to be program results.

This sub-committee has moved through three phases:

- the selection of a measurement model—the Performance Framework approach as in Evaluation and Performance Framework;
- the selection of key results areas;
- decision to report against strategic objectives.

Having completed the first three, they are about to enter a fourth phase, reporting approach.

There are four key results areas:

- **Advancement of Knowledge**—refers to contributions to science and technology knowledge, development of expertise in areas of particular importance to Canada, attracting non-government partners to projects and fostering knowledge diffusion;
- **Innovation with Firms**—intended to get new goods and services (or improvements on existing ones) into commercial use;
- **Innovation Systems Support**—develop and improve networking among the various players in the innovation system; promote and diffuse knowledge; provide advice to government on science and technology; according to Bob McDonald, regulatory activity fits in here;

- Management—how to manage S&T in government better: includes planning, participation, client service, and measurement....all for the purpose of improving the performance of S&T projects.

Reporting against strategic objectives:

The sub-committee decided to report against strategic objectives and not in terms of the more than 50 individual projects. The value that they add is to raise the reporting to a higher level. At this stage, they do not have any performance measures against which to report progress. The sub-committee is in the process of reviewing the more than 50 projects with the aim of developing an approach for actual measurement. They will review what each organization now does for Performance Measurement. They want a scheme that relates the 50+ projects into the four key results areas.

Reporting approach:

Once they have developed a reporting approach, they foresee a challenge to convince the MCIP to put dollars into this last step.

While they have examples of the evaluation of S&T, they do not have examples of S&T performance measurement.

Interviewer Summary: "I did not get the impression that they were making progress. It sounds as if they have not yet found a solution to the problem of how to measure S&T performance (or S&T regulations) and are simply working away using the PMN [How? Who? Why?] model hoping that inspiration will one day appear." Gerald Halpern

Natural Resources Canada

CANMET - Minerals: Bob Hargreaves

The Laboratory has been split from its energy counterpart, and now has approximately 160 people, from a high of 300 only a few years ago. Now they do a much higher proportion of contracting-in, i.e. work for industry for which CANMET receives payment. This contracted work totals about \$5M, one third of the total budget of \$15M. They do almost no contracting-out, i.e. CANMET purchasing work from outside research contractors.

Their performance tracking system reflects this distribution of effort.

The process begins with a business plan which identifies major areas of interest to the government and industry. From this, they develop a detailed plan for core projects, with all the resource allocation, milestones, deliverables, and an expression of interest from industry. These are developed by the program staff. The ideas for projects are drawn from several sources, but are industry-driven, with some consideration for a return on investment for the tax payer.

At the conclusion of the project, there is an internal review which answers the following questions: have we done what we intended to do, did we spend the money as we intended, does the plan still look good (for projects reviewed in mid-life), is there relevant work going on elsewhere, did we generate any publications, are there any recommendations emerging from work.

For work that is contracted by outside clients, the first stage is a detailed proposal, and the criterion is value for dollar to the client. Clients are surveyed at the very beginning as to whether the *proposal* meets their expectations. Ongoing relationship is maintained by regular meetings with the client, monthly invoicing (if they pay up, they must be happy...), and monthly progress reports, with detailed comments.

At the end of the project, clients are asked, again through a form/interview, whether the project met their expectations, both technical and financial. Lastly, after a longer period, ranging from 1 to 4 years after completion, clients are surveyed one more time as to the nature of the impact on performance, job creation, productivity. Clients are asked to quantify these impacts as much as possible, including cost savings.